

ATARI 400 48K MEMORY MODIFICATION INSTRUCTIONS

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The following instructions will describe a step-by-step procedure for upgrading an ATARI 400 16K memory to 48K. This will allow the ATARI 400 to use nearly all of the software and peripherals available for the ATARI 800, including the ATARI 810 disk drive.

Once modified, the new memory will actually consume less power than did the original 16K, and will present absolutely no potential for damage to the rest of the ATARI 400 circuitry.

The instructions presume an elementary electronics ability on the part of the user: simple mechanical, soldering, wiring, and parts identification knowledge (i.e., do you know the business end of a soldering iron, and can you find pin 13 of an integrated circuit?). All parts on the ATARI circuit boards are clearly labeled, and these instructions and diagrams are quite complete, so it is likely that even a novice should have little difficulty if the instructions are followed precisely.

No trouble-shooting instructions are given, because it is impossible to test the ATARI memory without test equipment and a test jig or extender cable. If a modified memory does not work, the best procedure is to review the instructions and carefully inspect the workmanship of the modifications.

Implementation of these instructions will most definitely void the ATARI 90-day warranty, and it is doubtful that any ATARI service center would attempt to repair a modified unit. However, it may be possible to arrange service on a personal level with a smaller service center. Be sure to keep these instructions and diagrams for reference in the event the unit requires repair in the future.

A card modified as described here will not work in an ATARI 800, and these instructions do not apply to older 8K memory cards.

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PARTS REQUIRED:

<u>quantity</u>	<u>description</u>
3 feet	#30 insulated wire
(2)	1K 1/4w resistors
(1)	10 mfd. 10v. tantalum capacitor
(1)	74LS04 hex inverter
(1)	74LS158 quad 2-in mux
(8)	4164 200ns 4Kx1 dynamic RAM

NOTE: The values of the resistors and capacitor are not critical. Any resistor value from 480 ohms to 4.7K, and any capacitor value from 4.7 to 15 mfd and 10v or greater, will work fine.

NOTE: A suitable source for the 4164 dynamic RAM's is:

DoKay Computer Products
3250 Keller St. 99
Santa Clara, CA 95050

Their current (Feb 83) price is \$5.45 each, plus \$2 shipping, plus tax (\$48.22 total). The 74LS04 and 74LS158 may also be ordered from DoKay for 24 and 75 cents, respectively, plus tax (\$49.27 total). Phone (800) 848-8008 to order by bank card or to find out the current price (the price per eight chip set is presently decreasing at the rate of several dollars a month).

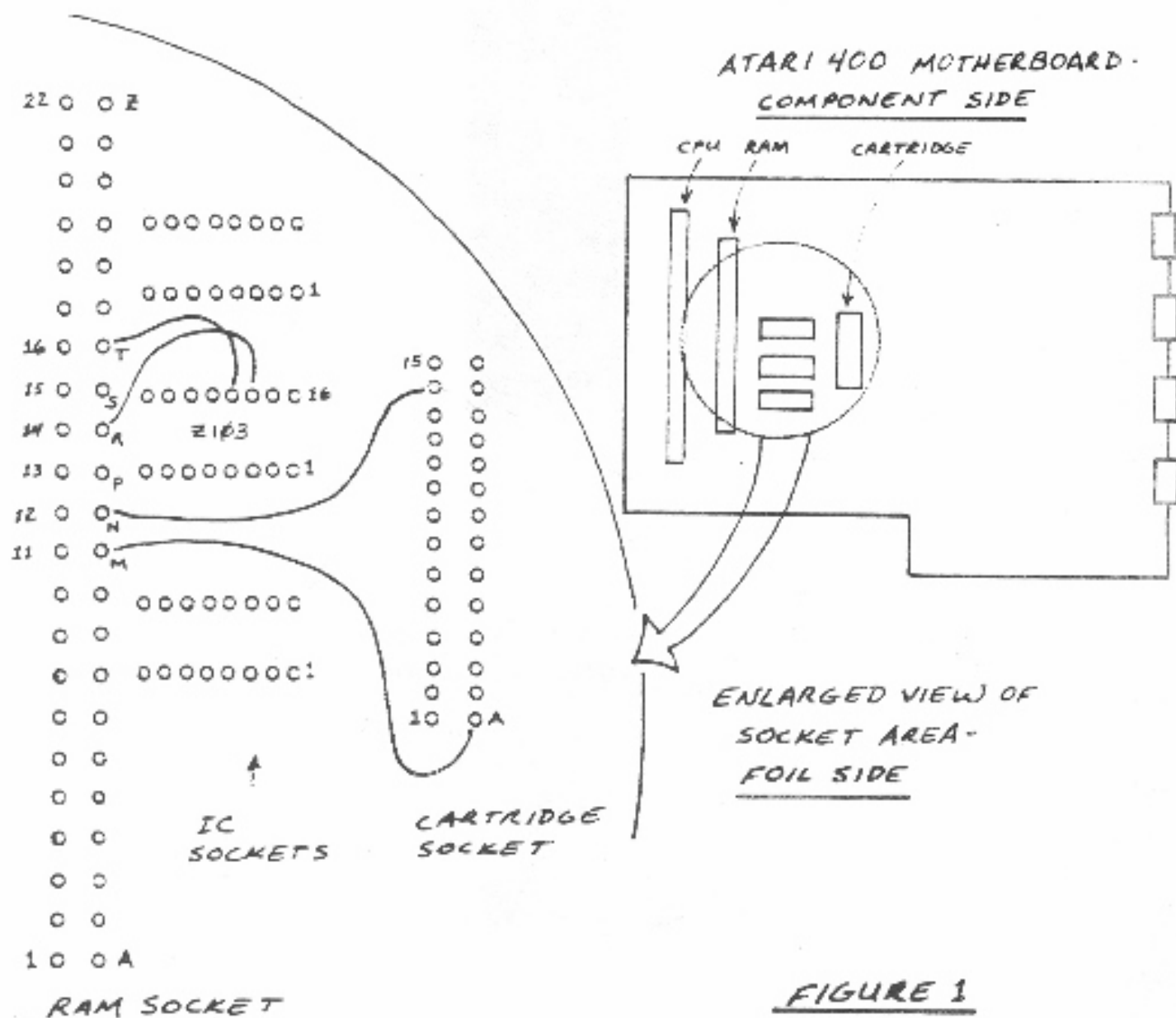
The wire, resistors, and capacitor can be found at Radio Shack or any electronics supply store.

TOOLS

<u>required</u>	<u>optional</u>
25 watt soldering iron (no larger!)	wire stripper
solder	DIP remover
wire cutter	DIP inserter
X-Acto knife	solder wick or
needle nose pliers	solder sucker
phillips screwdriver	

DISASSEMBLY

- 1.() Unplug the power, joystick, recorder and TV cables.
- 2.() Turn unit over and remove four phillips screws from the base.
- 3.() Turn unit upright, open the cartridge cover, and remove the top of the unit. The keyboard must be flexed to release it from the clip that attaches it to the top cover. Close the cartridge cover.



- 4.() Unplug the keyboard and remove it.
- 5.() Unplug the speaker and remove it.
- 6.() Note the routing of the TV cable, lift out the circuit board and metal enclosure assembly, and set it upside down to the right of the base. The circuit boards could be separated from the base by unplugging the TV cable but it should not be necessary to separate them.
- 7.() Remove the eight phillips screws that attach the metal shield to the bottom of the circuit board; remove the shield and the cardboard insulator beneath it.

MOTHERBOARD MODIFICATIONS

NOTE: These are the only modifications made to the ATARI 400 unit itself. They will preclude normal operation with a standard 16K memory card, but the unit may be returned to its original configuration by simply removing the jumper wires that will be added to the motherboard in the following steps.

NOTE: Alphabetical designations of ATARI sockets skip the letters C, I, O, and Q. This must be considered when identifying socket pins in the following steps.

8. As shown in Figure 1, add the following four jumper wires on the foil side of the mother board:
 - () From RAM socket pin M to cartridge socket pin A
 - () From RAM socket pin N to cartridge socket pin 14
 - () From RAM socket pin R to IC 2103 socket pin 14
 - () From RAM socket pin T to IC 2103 socket pin 13

DISASSEMBLY, continued

- 9.() The mother board is free of the large metal enclosure, but it is still plugged into the power supply board by a header connector between the boards. Disengage this connector by applying pressure between the boards to separate them, while keeping them parallel at all times.

- 10.() The motherboard is now completely free and may be lifted straight out of the metal enclosure. Turn the board over, unplug the 16K RAM card, and set the motherboard aside.

16K CARD MODIFICATIONS

- 11.() Remove IC's Z504 (74LS158) and Z501 (74LS10).
- 12.() Remove IC's Z505 thru Z512 (the eight memory chips).
- 13.() Remove capacitors C517, C513, C509, and C505. These capacitors look like glass diodes and may be either clipped out or unsoldered. If there is any doubt about completing the following modifications, they should be carefully unsoldered so that the board could be repaired and returned to normal operation if necessary.

NOTE: The trace cuts that are made in the following step are the only permanent modifications to the 16K card. To cut a trace, make two parallel cuts thru the trace, about 1/16" apart. Cut deeply enough to go thru the foil. Then with the tip of the knife, peel the foil completely away between the cuts. If it is necessary to return the card to its normal 16K operation a cut may be repaired by first scraping the solder mask (green coating) off the foil near the cut, then soldering a bit of wire across the cut.

14. Make trace cuts at the following six locations:
- () C1 on the component side (Figure 2A)
 - () C2 on the component side (Figure 2A)
 - () C3 on the foil side (Figure 2B)
 - () C4 on the foil side (Figure 2B)
 - () C5 on the foil side (Figure 2B)
 - () C6 on the foil side (Figure 2B)
- 15.() Using a bit of bare wire, install a jumper at J1 (see Figure 2B).

NOTE: The two resistors and capacitor will be installed in the following steps. The circuit board has unused feedthru holes next to the existing capacitors at the indicated points, that are probably filled with solder. Clear out the feedthru holes using a solder sucker or solder wick. Alternately, the new components could be attached to the leads of the existing capacitors.

- 16.() Connect one lead of a 1K resistor to the empty feedthru at the right end of capacitor C522 as shown in Figure 2A. Connect one lead of the other 1k resistor to the empty feedthru at the right end of capacitor C523. These two capacitors are located in the lower right corner of the circuit board to the right of Z501. Bend the body of each resistor down so that they lay alongside the capacitors. Cut the free lead of each resistor to 1/8".
- 17.() Install the 10 mfd tantalum capacitor across existing capacitor C501. C501 is located at the pin 1 end of Z501. OBSERVE POLARITY of the tantalum capacitor: its positive lead, designated by a dot or a + sign, MUST be oriented as shown in Figure 2A, towards the connector edge of the board.
- 18.() On the removed 74LS158, bend pins 5, 9, 10, and 11 straight out from the body of the IC (see Figure 3).
- 19.() Reinsert the 74LS158 into its socket at Z504.
- 20.() On the removed 74LS10, bend pins 1 and 13 straight out from the body of the IC.
- 21.() Reinsert the 74LS10 into its socket at Z501.
- 22.() On the new 74LS158, bend all pins except 8 and 16, straight out from the body of the IC.
- 23.() Place the new 74LS158 "piggyback" on top of the 74LS158 at Z504. Pin 8 of the new chip should touch pin 8 of the bottom chip; likewise pins 16 should touch. Solder pins 8 and 16 of the piggybacked IC to Z504.
- 24.() On the new 74LS04, bend all pins except 7 and 14, straight out from the body of the IC.
- 25.() Place the new 74LS04 "piggyback" on top of the 74LS10 at Z501. Pin 7 of the new chip should touch pin 7 of the bottom chip; likewise pins 14 should touch. Solder pins 7 and 14 of the piggybacked IC to Z501.
26. Using bare #30 wire, install the following connections between pins of the 74LS04 that is piggyback at Z501 (see figure 3).
 - () pin 2 to pin 3
 - () pin 4 to pin 5
 - () pin 6 to pin 9 (lay this wire directly across the top of the IC)

27. Install the following wires from the indicated IC's to the indicated tap points on the board (see Figure 2A), using insulated #30 wire.
- () T1 to 74LS04 pin 8
 - () T2 to bottom 74LS158 (Z504) pin 9
 - () T3 to upper 74LS158 pin 1
 - () T4 to bottom 74LS158 pin 10
 - () T5 to 74LS04 pin 13
 - () T6 to 74LS04 pin 11
 - () T7 to upper 74LS158 pin 15
 - () T8 to 74LS10 (Z501) pin 1
 - () T9 to 74LS04 pin 1
28. To the free ends of the resistors installed at T10 and T11, make the following connections using #30 insulated wire.
- () RT10 to 74LS04 pin 13
 - () RT11 to 74LS04 pin 11
29. Install the following connections between pins of the indicated IC's, using #30 insulated wire.
- () upper 74LS158 pin 12 to 74LS10 (Z501) pin 13
 - () upper 74LS158 pin 13 to 74LS04 pin 10
 - () upper 74LS158 pin 14 to 74LS04 pin 12
 - () upper 74LS158 pin 15 to lower 74LS158 (Z504) pin 11
 - () lower 74LS158 (Z504) pin 5 to 74LS10 (Z501) pin 1
30. () While observing proper orientation, carefully insert the eight new 4164 memory chips in sockets Z505 thru Z512. Note that these chips are susceptible to static electricity damage and should not be handled more than necessary.

ASSEMBLY

31. () Reinsert the RAM card, and the CPU card if it was removed, into their respective sockets on the motherboard. Note that the component sides of the boards face the nearest edge of the motherboard (the boards can be inserted backwards, and if you do, all bets are off).
32. () Place the motherboard in position on the metal enclosure. Align the connector between the motherboard and power supply, and mate the connector by pressing the boards together.

- 33.() Replace the cardboard insulator and metal shield; reinsert and tighten the eight phillips screws.
- 34.() Properly route the TV cable and set the assembly into the base of the unit.
- 35.() Replace the speaker and plug it in.
- 36.() Plug in the keyboard.
- 37.() Open the cartridge cover, fit the top cover on the unit, and snap the keyboard back into place.
- 38.() Turn the entire unit over, replace and tighten the four phillips screws.

TESTING

- 39.() Reconnect the power and TV cables, plug in the BASIC cartridge, and turn on the power. The READY prompt should be displayed.
- 40.() Type PRINT FRE(0)
The amount of free memory, 37902, should be displayed; this confirms that the computer recognises it has 48K of memory available.

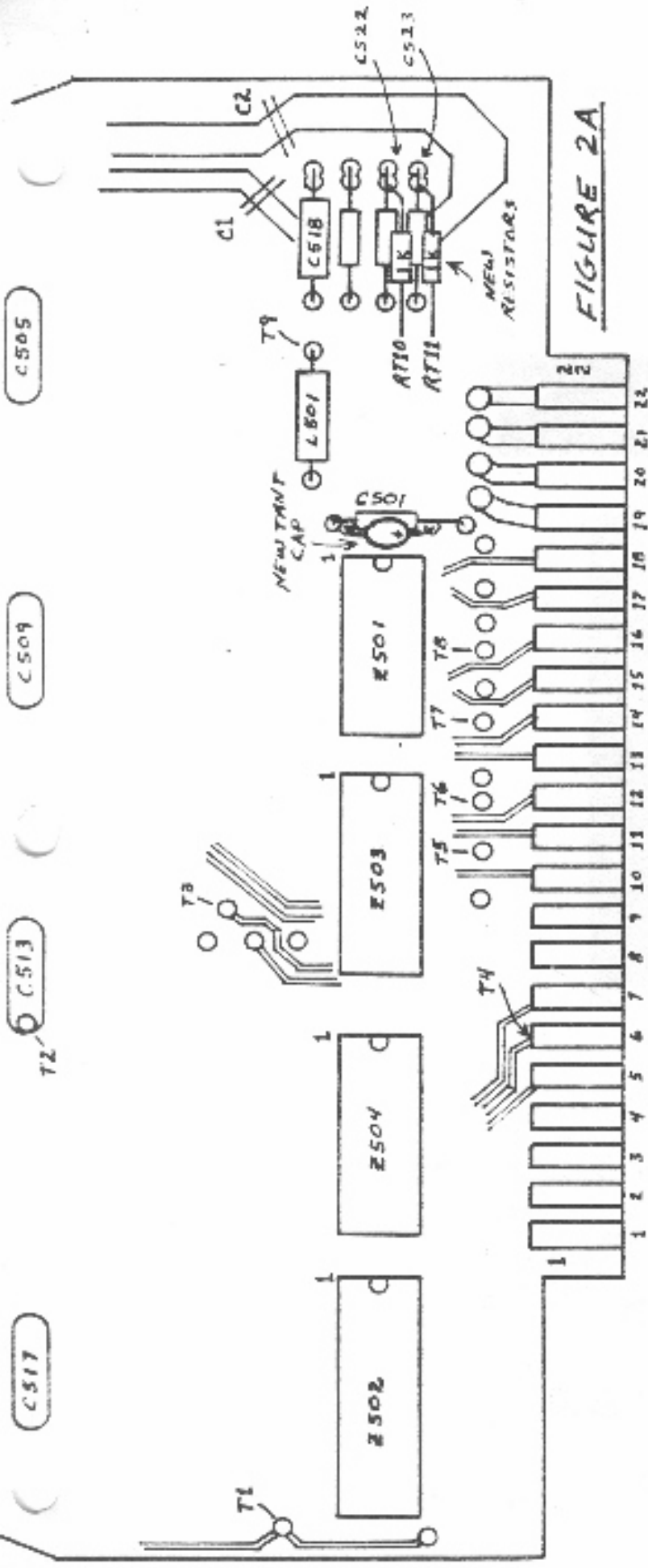


FIGURE 2A

ATARI 16K CARD - MOD FOR 48K

COMPONENT SIDE
FOIL SIDE

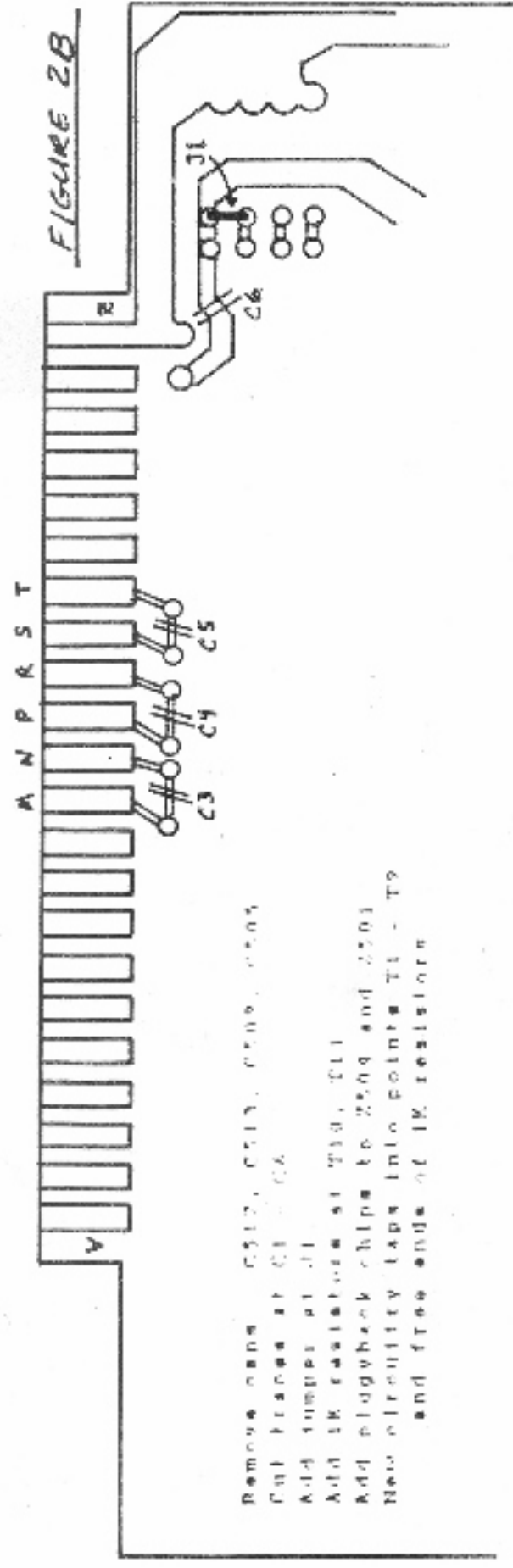


FIGURE 2B

Remove caps C512, C513, C514, C515, C516
Cut traces at C1 - C4
Add jumper at J1
Add 1K resistor at T10, T11
Add electrolytic chips to R59 and R60
Now electricity taps into points T1 - T6
and free ends of 1K resistors

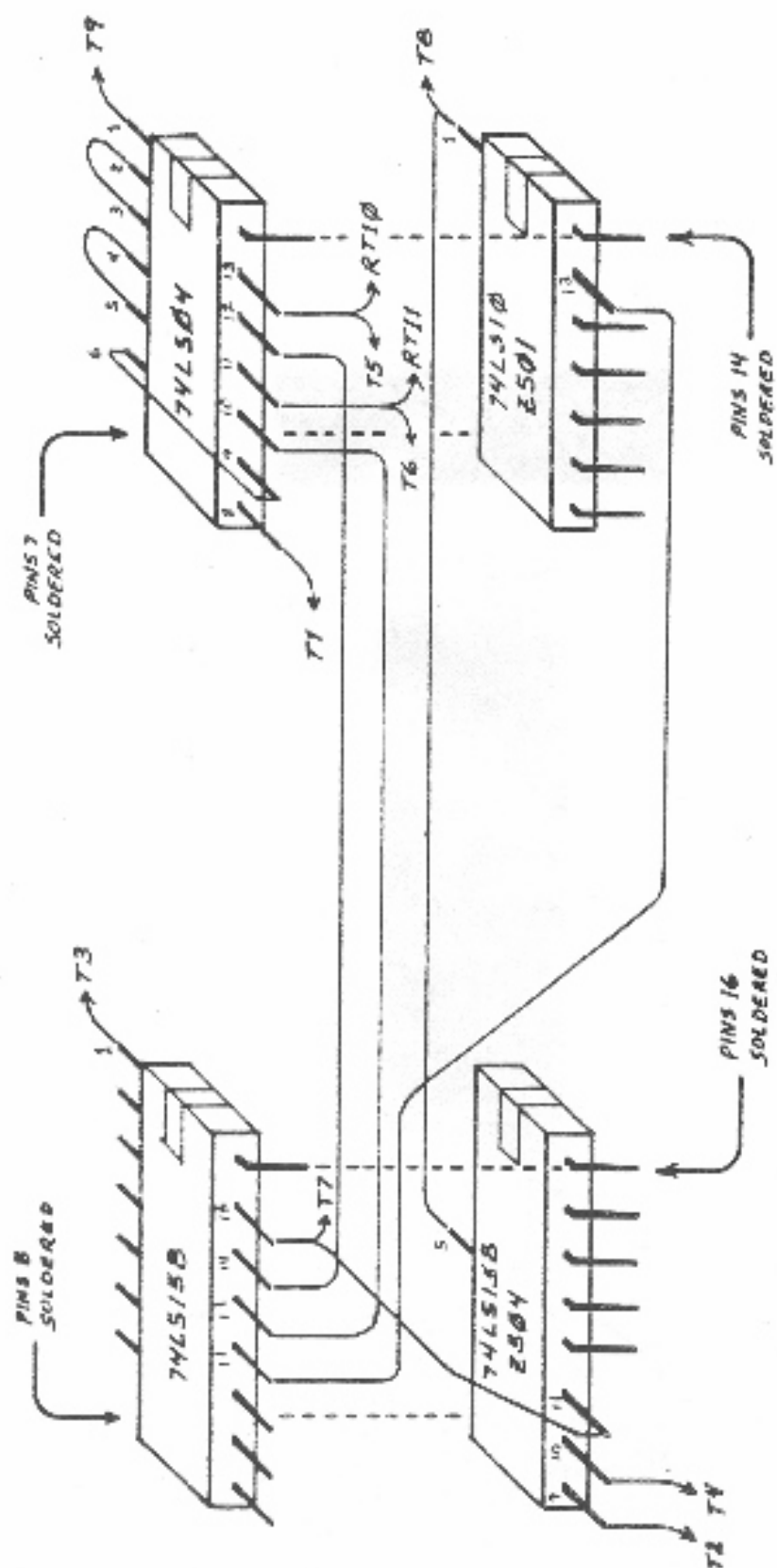


FIGURE 3

ATARI 400 48K MEMORY MODIFICATION TECHNICAL DESCRIPTION

Modification of the ATARI 16K memory card for 48K is not quite as simple as replacing the 16K chips with 64K chips. Changes must be made to the circuitry in the areas of power distribution, address multiplexing, -CAS generation, and select decoding.

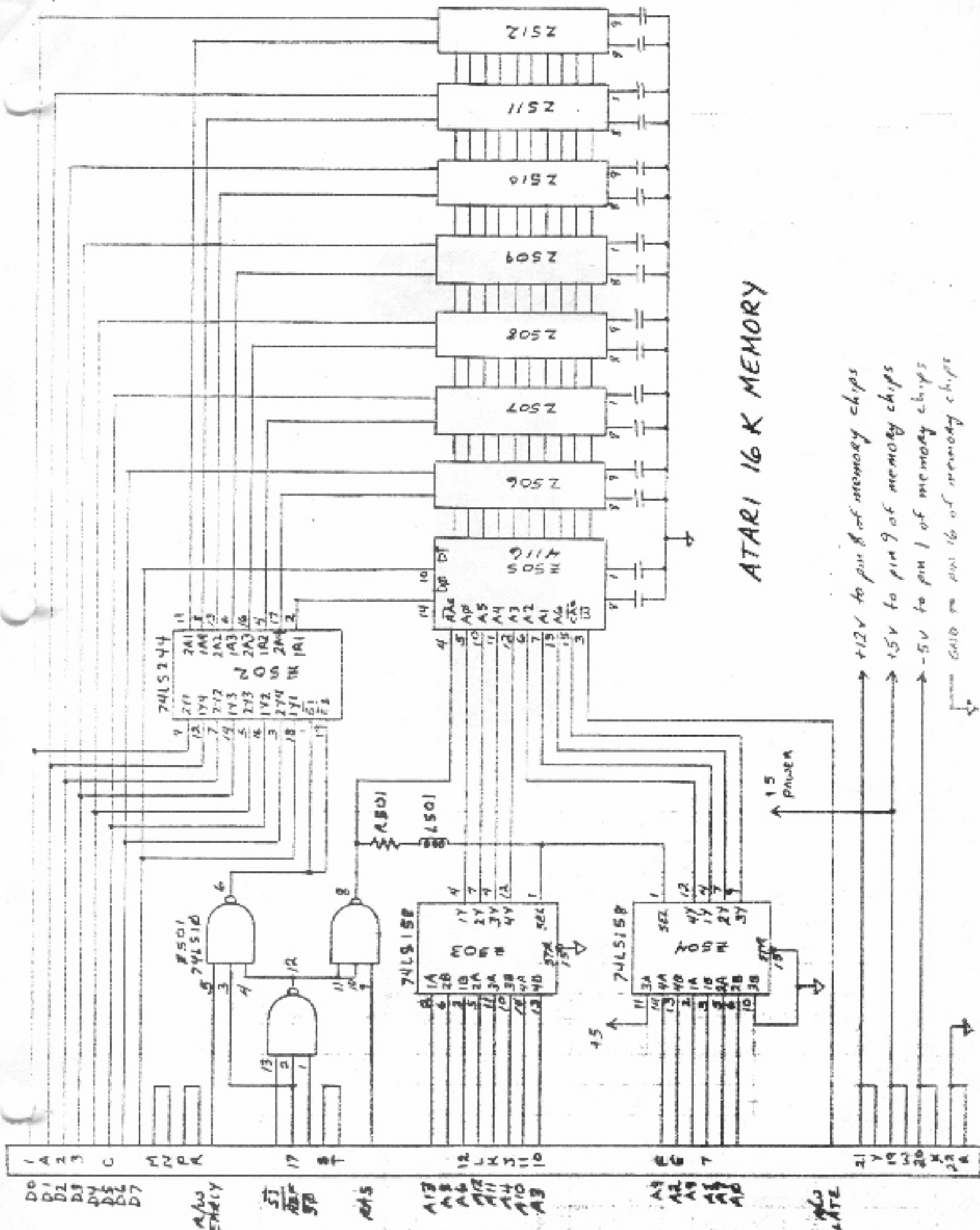
Power pins of the 4164 RAM are different than those of the 4116 used on the 16K card. The 4164 uses only +5v, while the 4116 requires +12, +5, and -3v. On the modified card, the +12 and -5 supplies are cut out completely, and the RAM +12v connections are jumped to supply +3v for the 4164's. RAM pins 9 are used for the A7 address line in the 4164, so this line is disconnected from the +5 supply and the bypass capacitors are removed from it. While the average current drawn by the 4164 is lower than the 4116, the instantaneous current is apparently higher, so a bulk bypass capacitor is necessary to reduce screen interference.

Address lines A14 and A15 must be brought onto the card and multiplexed to the 4164. To accomplish this, section 3 of Z304 is wired as an address mux rather than the -CAS circuit. The resulting multiplexed address line is connected to pin 9 of the memory array.

To replace the -CAS circuit, four inverters are cascaded to provide -CAS from the -RASD signal. The inverters provide the delay necessary to meet the column address set-up time of the 4164. The original circuit would not have safely met the set-up requirement of the 4164, which is different than that of the 4116.

The new 74LS138 is added to provide a card select circuit to replace the S0 and S1 memory block select signals. A15 enables the card when the address is in the lower 32K. RD4 and RD5 are pulled high to disable the 32-40 and 40-48K memory blocks respectively, whenever a ROM cartridge is inserted using that memory space. A13, A14, -RD4, and -RD5 are decoded by the 74LS138 to provide a select signal whenever one of those memory blocks is addressed but not disabled by a cartridge.

The following two schematics show the circuitry of the 16K card before modification, and the portion of the card's circuitry that is changed by the 48K modification.



ATARI 16K MEMORY

- +12V to pin 8 of memory chips
- +5V to pin 9 of memory chips
- -5V to pin 1 of memory chips
- GND to pin 16 of memory chips

ATARI 400 48K MEMORY MODIFICATIONS

